REQUEST FOR A SPECIAL PROJECT 2012–2014

MEMBER STATE: SPAIN

Principal Investigator[1]: JOAN CUXART RODAMILANS

Affiliation: UNIVERSITAT DE LES ILLES BALEARS

Address: DEPARTAMENT DE FÍSICA, EDIFICI MATEU ORFILA
CRA. VALLDEMOSSA, KM 7.5
07122 – PALMA DE MALLORCA (ILLES BALEARS) SPAIN

E-mail: joan.cuxart@uib.cat

Other researchers:
MARIA A. JIMÉNEZ CORTÉS,
DANI MARTÍNEZ VILLAGRASA

Project Title:

Atmospheric Boundary Layer processes in Complex Terrain

If this is a continuation of an existing project, please state the computer project account assigned previously.	**No, but SPESTURB existed 02-11**	
Starting year: (Each project will have a well defined duration, up to a maximum of 3 years, agreed at the beginning of the project. For projects started before 2009, please state 2009 as the start year.)	2012	
Would you accept support for 1 year only, if necessary?	YES X ☐	NO ☐

Computer resources required for 2012-2014: (The maximum project duration is 3 years, therefore a continuation project cannot request resources for 2013.)	**2012**	**2013**	**2014**
High Performance Computing Facility (units)	150000	150000	150000
Data storage capacity (total archive volume) (gigabytes)	200	200	200

*An electronic copy of this form **must be sent** via e-mail to:* *special_projects@ecmwf.int*

Electronic copy of the form sent on (please specify date):
04/19/11

Continue overleaf

[1] The Principal Investigator will act as contact person for this Special Project and, in particular, will be asked to register the project, provide an annual progress report of the project's activities, etc.

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Extended abstract

It is expected that Special Projects requesting large amounts of computing resources (500,000 SBU or more) should provide a more detailed abstract/project description (3-5 pages) including a scientific plan, a justification of the computer resources requested and the technical characteristics of the code to be used. The Scientific Advisory Committee and the Technical Advisory Committee review the scientific and technical aspects of each Special Project application. The review process takes into account the resources available, the quality of the scientific and technical proposals, the use of ECMWF software and data infrastructure, and their relevance to ECMWF's objectives. - Descriptions of all accepted projects will be published on the ECMWF website.

Recent progress on Atmospheric Boundary Layer (ABL) over land has been focused on the improvement of the description of the diurnal cycle, including boundary layer clouds. The ***GEWEX Atmospheric Boundary Layer Study (GABLS)*** of the WCRP has shown the state-of-the-art of the dry ABL during the last decade, with special interest on the physical processes that prevail in the nocturnal part of the cycle and in the transitions, evaluating the performances of the available parameterization schemes.

The members of this proposed project have been active in GABLS, participating in some of the intercomparisons with single-column and Large-Eddy Simulations, the later computed in ECMWF in the frame of the former project SPESTURB and his national associated project ESTURB. In the last five years, however, a large part of the computing time has been used to make high-resolution mesoscale simulations for some selected topographical basins where special experimental data were available (Mallorca Island, Duero basin, Hudson basin and Ebro basin). This is justified by the fact that point measurements (and the corresponding single-column and Large-Eddy simulations) cannot be understood without characterizing the effects of the surrounding heterogeneity which, over land, means basically to take into account the effects of topography and terrain discontinuities.

Most special in-situ measurements, like the sites of Cabauw, Lindenberg, Valladolid and others, are basically column measurements, even if supplied by a variety of devices. Very often in clear nights, these sites have flows of well defined direction that cannot be explained by the synoptic pressure gradient, and they determine the thermal evolution near the surface. Our main aim during the last years has been to understand the origin and behaviour of these flows, through data analysis of the available instruments, remote sensing information and numerical modeling. Our findings seem to point in the direction of mesobeta within-basin circulations induced by the main features of the basin, like mountain ranges, slopes, river valleys or wide irrigated areas. To reproduce these low-level circulations, the price to pay is to have a very high vertical resolution near the surface to be able to capture properly the advective transport and the associated turbulence mixing associated to the wind shear. A number of papers published recently justify the interest of this approach (see the Progress Report of Spesturb project).

In recent observational and numerical experiments we have been investigating also the contribution of the small-scale variability to the point measurements. These small-scale terrain features may contribute significantly to the observed values of the meteorological variables in point observations, specially through the local thermal gradients which will induce micro-circulations. These local advections, very variable from point to point, may explain partly the differences between local measurements and grid-averaged values from numerical models. We intend to measure these effects in a flat square of 160m x 160 m during the BLLAST experiment (Lannemezan, France, summer 2011) using small UAVs and multicopters to sample the internal heterogeneity of the square, which has wet and dry areas and different types of vegetation, and to try to model the air above the square during the evening transition and the night through Large-Eddy Simulation. Luckily enough, the mesobeta scale is expected to be well defined since weak downslope flows will prevail and provide relatively easy to handle lateral boundary conditions. This particular feature will be provided by the BLLAST measurements and the corresponding mesoscale simulations.

In the next three years we plan to characterize within-basin circulations generated by thermal heterogeneities, focusing mostly in basins where observational information is available (Ebro, Duero, Garonne-BLLAST, Mallorca) through high-resolution mesoscale modeling (horizontal resolutions of the order of 1 km and vertical resolutions in the ABL of few meters), investigating the diurnal cycle of the barocline circulations. On the other hand we plan to do a realistic Large-Eddy simulation of the BLLAST small-scale square to investigate the role of weak surface temperature heterogeneities.